Performance of Cost and Economics of 9-Bus System

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***Abstract* - *The optimal power flow (OPF) problem seeks to control the generation/consumption of generators/loads to optimize certain objectives such as to minimize the generation cost or power loss in the network. It is becoming increasingly important for distribution networks due to the emerging distributed generation and controllable loads. The project aims to study the performance of 9-bus system by conducting various load flow studies. The study of economics of power system is important for optimum operation of the system . project deals with both load flow studies and cost economics studies which has been conducted.*

Key Words: *Optimal power flow, power world simulator, voltage security, SVC*

I INTRODUCTION

Power World Simulator is a power system simulation package designed from the ground up to be user-friendly and highly interactive. Simulator is actually a number of integrated products. At its core is a comprehensive, robust Power Flow Solution engine capable of efficiently solving systems of up to 60,000 buses. This makes Simulator quite useful as a stand alone power flow analysis package. Unlike other commercially available power flow packages, however, Simulator allows the user to visualize the system through the use of full-color animated oneline diagrams with full zooming and panning capability. Moreover, system models may be modified on the fly or even built from scratch using Simulator's full featured graphical case editor. Transmission lines may be switched in or out of service, new transmission or generation may be added, and new transactions may be established, all with a few mouse clicks. Simulator's extensive use of graphics and animation greatly increases the user's understanding of system characteristics, problems, and constraints, as well as of how to remedy them.

1.1 PERFORMANCE OF COST AND ECONOMICS

The objective is to minimize the real and reactive power losses in the system and to maximize the total saving and cost of conducting material while maintaining the acceptable voltage levels. It is observed that the number of computations is more in conventional method than genetic algorithm. Power is the rate of flow of energy**.** Similarly, generating capacity is the ability to produce power is itself a flow. A megawatt (MW) of capacity is worth little if it lasts only a minute just as a MW of power delivered for only a minute is worth little. But a MW of power or capacity that flows for a year is quite valuable. The price of both power and energy can be measured in RS/MWh, and since capacity is a flow like power and measured in MW, like power, it is priced like power, in RS/MWh. Many find this confusing, but an examination of screening curves.

II LITERATURE SURVEY

Simulator can model generators as not having a cost model, or having either a cubic cost model or a piecewise linear model. The cost model type you choose determines the content of the remainder of this dialog

a. Unit Fuel Cost
b. Fixed Costs (Costs At Zero Mw Output)
c. Cubic Cost Coefficients A, B, C, D
d. Piecewise Linear Table
e. Convert Cubic Cost To Linear
f. Measuring Power And Energy

2.1 ECONOMIC DISPATCH

Economic dispatch is the method of determining the most efficient, low-cost and reliable operation of a power system by dispatching the available electricity generation resources to supply the load on the system. The primary objective of economic dispatch is to minimize the total cost of generation while honoring the operational constraints of the available generation resources. Economic Dispatch is the process of allocating the required load demand between the available generation units such that the cost of operation is minimized. There have been many algorithms proposed for economic dispatch: Merit Order Loading, Range Elimination, Binary Section, Secant Section, Graphical/Table Look-Up, Convex Simplex, Dantzig-Wolf Decomposition, Separable Convex Linear Programming, Reduced Gradient with Linear Constraints, Steepest

2.2 CLASSIFICTION OF CHARGES

To deduce the power generation economics effectively we should know the structure of annual expenditure of the plant and the factors affecting them. The total annual expenditure of the plant can be classified into

- Fixed Charges
- Semi fixed Charges
- Running Charges

Working Summary

Readers wishing to gain only a working knowledge of measurement units for use in later chapters should understand the following.

Quantity	Quantity units	Price Units
Energy	MWh	\$/MWh
Power	MW	\$/MWh
Capacity	MW	\$/MWh
Cost	**Symbol**	**Cost Units**
Fixed	FC	\$/MWh
Variable	VC	\$/MWh
Average	$AC_K = FC + cf \times VC$	\$/MWh
Average	$AC_E = FC/cf + VC$	\$/MWh
Ratio	**Symbol**	**Units**
Capacity factor	cf	none
Duration	D	none

a. Fixed Cost:
Fixed costs are not permanently fixed; they will change over time, but are fixed in relation to the quantity of production for the relevant period. For example, a company may have unexpected and unpredictable expenses unrelated to production, such as warehouse costs and the like that are fixed only over the time period of the lease.

b. Semi Fixed Cost:
These charges mainly depend on the installed capacity of the plant and are independent of the electrical energy output of the plant. These charges include the following ,Interest on the capital cost of the generating plant, transmission and distribution network, buildings and other civil engineering works etc.

c. Running Cost
The running charges is one of the most important parameters while considering the economics of power generation as it depends upon the number of hours the plant is operated or upon the number of units of electrical energy generated. It essentially consists of the following costs.In case of a thermal power plant, power generation economics includes the cost of feed water for the boiler, like the cost of water treatment and conditioning

III MODELLING & SIMULATION

This paper studies the optimal power flow (OPF) problem in distribution networks, which includes cost economics of 9-bus system following we present a model of this scenario that serves as the basis for our analysis. The model incorporates power flow in 9 bus system which, considers a variety of devices including distributed generators, transformers, controllable loads and allows for a wide range of control objectives such as minimizing the power loss or generation cost, which are described in turn.

3.1 TEST DATA FOR ANALYSIS OF SYSTEM

3.1.a.Bus Data

Bus										
Number	Name	Area Name	Nom Kv	PU Volt	Volt (kV)	Angle (Deg)	Load MW	Load Mvar	Gen MW	Gen Mvar
1	1	1	138	1	138	0			72.07	9.53
2	2	1	138	1	138	-17.42			85	-36.59
3	3	1	138	1	138	-11.21			163	-36.33
4	4	1	138	1.03226	142.452	-23.71				
5	5	1	138	1.03086	142.259	-24.32	90	0		
6	6	1	138	1.02575	141.553	-16.55				
7	7	1	138	1.02634	141.635	-21.13	100	0		
8	8	1	138	1	141.62	-21.13				
9	9	1	138	1	142.5	-15.12	150	0		

3.1.b.Branch Data

Bus From Number	To Number	R	X	B
1	4	0	0.576	0
2	2	0	0.0625	0
3	6	0	0.0586	0
4	5	0.017	0.092	0.158
5	9	0.01	0.085	0.176
6	6	0.039	0.17	0.358
7	7	0.0119	0.1008	0.209
8	8	0.0085	0.072	0.149
9	2	0	0.0625	0
10	9	0.032	0.161	0.306
11	4	0.01	0.085	0.176

3.1.c. Generator Data

Generator					
Number of Bus	Name of Bus	ID	Status	Gen MW	Gen Mvar
1	1	1	Closed	72.07	9.53
2	2	1	Closed	85	-36.59
3	3	1	Closed	163	-36.33

3.1.d. Generator Cost Data

Generator no	Bus no	Area	Starting cost	Shut down cost	Quadartic function coefficients cost		
					A	B	C
1	1	A	1500	0	150	5	0.11
2	2	B	2000	0	600	1.2	0.085
3	3	C	3000	0	335	1	0.1225

3.2 ELECTRIC MODEL
3.2.1 SINGLE LINE DIAGRAM

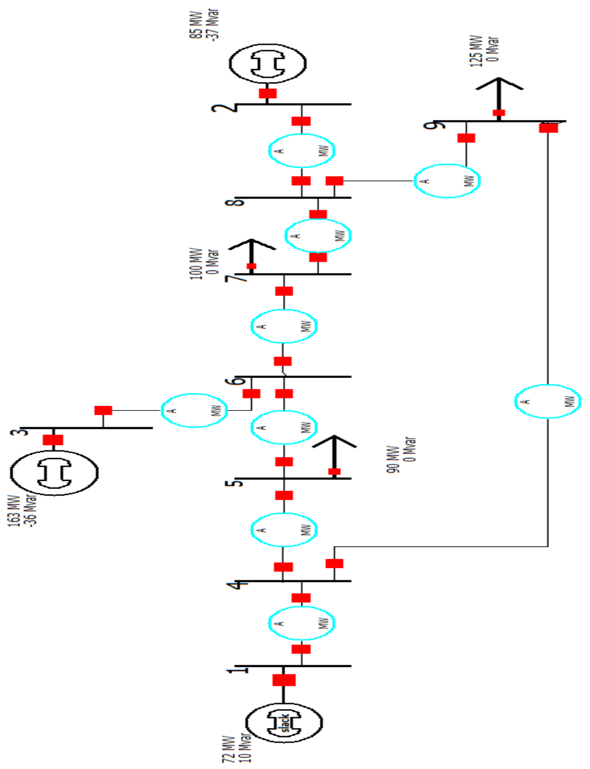

Fig.1 single line diagram for test data

IV SIMULATION RESULTS

4.1 STABLE SYSTEM
4.1.a Bus data

	Number	Name	Area Name	Nom kV	PU Volt	Volt (kV)	Angle (Deg)	Load MW	Load Mvar	Gen MW	Gen Mvar	Switched Shunts Mvar	Act G Shunt MW	Act B Shunt Mvar	Area Num
1	1	1	1	138.00	1.00000	138.000	0.00			68.81	11.87		0.00	0.00	1
2	2	2	1	138.00	1.00000	138.000	-8.81			165.00	-21.97		0.00	0.00	1
3	3	3	1	138.00	1.00000	138.000	-9.82			150.00	-27.11		0.00	0.00	1
4	4	4	1	138.00	1.01243	139.715	-23.05						0.00	0.00	1
5	5	5	1	138.00	1.00452	138.624	-25.38	150.00	0.00				0.00	0.00	1
6	6	6	1	138.00	1.01968	140.716	-14.77						0.00	0.00	1
7	7	7	1	138.00	1.02122	140.928	-17.04	100.00	0.00				0.00	0.00	1
8	8	8	1	138.00	1.01896	140.617	-14.62						0.00	0.00	1
9	9	9	1	138.00	1.01060	139.462	-24.17	125.00	0.00				0.00	0.00	1

Fig: Bus Data For Stable System

4.1.b Branch Data

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	MW From	Mvar From	MVA From	Lim MVA	% of MVA Limit (Max)	MW Loss	Mvar Loss
1	1	1	4	4	1	Closed	Line	NO	68.8	11.9	69.8	0.0	0.0	0.00	28.08
2	8	8	2	2	1	Closed	Line	NO	-165.0	39.3	169.6	0.0	0.0	0.00	17.32
3	3	3	6	6	1	Closed	Line	NO	150.0	-27.1	152.4	0.0	0.0	0.00	13.62
4	4	4	5	5	1	Closed	Line	NO	45.2	-6.8	45.7	0.0	0.0	0.34	-14.23
5	4	4	9	9	1	Closed	Line	NO	23.6	-9.4	25.4	0.0	0.0	0.05	-17.55
6	5	5	6	6	1	Closed	Line	NO	-105.1	7.4	105.4	0.0	0.0	4.52	-16.96
7	6	6	7	7	1	Closed	Line	NO	40.4	-16.4	43.6	0.0	0.0	0.19	-20.16
8	7	7	8	8	1	Closed	Line	NO	-59.8	3.8	60.0	0.0	0.0	0.30	-12.94
9	8	8	9	9	1	Closed	Line	NO	104.9	-22.6	107.3	0.0	0.0	3.40	-14.39

Fig: Branch Data For Stable System

4.1.c Generator data

	Number of Bus	Name of Bus	ID	Status	Gen MW	Gen Mvar	Set Volt	AGC	AVR	Min MW	Max MW	Min Mvar	Max Mva	Cost Model	Part. Factor
1	1	1	1	Closed	68.81	11.87	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00
2	2	2	1	Closed	165.00	-21.97	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00
3	3	3	1	Closed	150.00	-27.11	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00

Fig: Generator Data For Stable System

4.2 SYSTEM WHEN GENERATOR 1 IS OPENED

Simulation results when generator 1 is opened

4.2.a. Bus data

	Number	Name	Area Name	Nom kV	PU Volt	Volt (kV)	Angle (Deg)	Load MW	Load Mvar	Gen MW	Gen Mvar	Switched Shunts Mvar	Act G Shunt MW	Act B Shunt Mvar	Area Num
1	1	1	1	138.00	0.99370	137.130	-32.67			0.00	0.00		0.00	0.00	1
2	2	2	1	138.00	1.00000	138.000	-8.81			240.26	3.73		0.00	0.00	1
3	3	3	1	138.00	1.00000	138.000	-15.25			150.00	-15.37		0.00	0.00	1
4	4	4	1	138.00	0.99370	137.130	-32.67						0.00	0.00	1
5	5	5	1	138.00	0.98540	135.985	-33.70	150.00	0.00				0.00	0.00	1
6	6	6	1	138.00	1.01283	139.770	-20.23						0.00	0.00	1
7	7	7	1	138.00	1.01205	139.663	-20.97	100.00	0.00				0.00	0.00	1
8	8	8	1	138.00	1.00891	139.229	-17.37						0.00	0.00	1
9	9	9	1	138.00	0.98642	136.126	-31.60	125.00	0.00				0.00	0.00	1

Fig: Bus Data When Generator 1 Is Opened

4.2.b. Branch data

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	R	X	B	Lim MVA A	Lim MVA B	Lim MVA C
1	1	1	4	4	1	Closed	Line	NO	0.00000	0.57600	0.00000	0.0	0.0	0.0
2	8	8	2	2	1	Closed	Line	NO	0.00000	0.06250	0.00000	0.0	0.0	0.0
3	3	3	6	6	1	Closed	Line	NO	0.00000	0.05860	0.00000	0.0	0.0	0.0
4	4	4	5	5	1	Closed	Line	NO	0.01700	0.09200	0.15800	0.0	0.0	0.0
5	4	4	9	9	1	Closed	Line	NO	0.01000	0.08500	0.17600	0.0	0.0	0.0
6	5	5	6	6	1	Closed	Line	NO	0.03900	0.17000	0.35800	0.0	0.0	0.0
7	6	6	7	7	1	Closed	Line	NO	0.01190	0.10080	0.20900	0.0	0.0	0.0
8	7	7	8	8	1	Closed	Line	NO	0.00850	0.07200	0.14900	0.0	0.0	0.0
9	8	8	9	9	1	Closed	Line	NO	0.03200	0.16100	0.30600	0.0	0.0	0.0

Fig: Branch Data When Generator 1 Is Opened

4.2.c.Generator data

	Number of Bus	Name of Bus	ID	Status	Gen MW	Gen Mvar	Set Volt	AGC	AVR	Min MW	Max MW	Min Mvar	Max Mva	Cost Model	Part. Factor
1	1	1	1	Open	0.00	0.00	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00
2	2	2	1	Closed	240.26	3.73	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00
3	3	3	1	Closed	150.00	-15.37	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00

Fig: Generator Data When Generator 1 Is Opened

4.3 SYSTEM WHEN GENERATOR 1 AND 2 ARE OPENED

Simulation results when generator 2 is opened are

4.3.a.Bus data

	Number	Name	Area Name	Nom kV	PU Volt	Volt (kV)	Angle (Deg)	Load MW	Load Mvar	Gen MW	Gen Mvar	Switched Shunts Mvar	Act G Shunt MW	Act B Shunt Mvar	Area Num
1	1	1	1	138.00	0.99370	137.130	-32.67			0.00	0.00		0.00	0.00	1
2	2	2	1	138.00	1.00000	138.000	-8.81			240.26	3.73		0.00	0.00	1
3	3	3	1	138.00	1.00000	138.000	-15.25			150.00	-15.37		0.00	0.00	1
4	4	4	1	138.00	0.99370	137.130	-32.67						0.00	0.00	1
5	5	5	1	138.00	0.98540	135.985	-33.70	150.00	0.00				0.00	0.00	1
6	6	6	1	138.00	1.01283	139.770	-20.23						0.00	0.00	1
7	7	7	1	138.00	1.01205	139.663	-20.97	100.00	0.00				0.00	0.00	1
8	8	8	1	138.00	1.00891	139.229	-17.37						0.00	0.00	1
9	9	9	1	138.00	0.98642	136.126	-31.60	125.00	0.00				0.00	0.00	1

Fig: Bus Data When Generator 1 And 2 Are Opened

4.3.b.Branch data

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	R	X	B	Lim MVA A	Lim MVA B	Lim MVA C
1	1	1	4	4	1	Closed	Line	NO	0.00000	0.57600	0.00000	0.0	0.0	0.0
2	8	8	2	2	1	Closed	Line	NO	0.00000	0.06250	0.00000	0.0	0.0	0.0
3	3	3	6	6	1	Closed	Line	NO	0.00000	0.05860	0.00000	0.0	0.0	0.0
4	4	4	5	5	1	Closed	Line	NO	0.01700	0.09200	0.15800	0.0	0.0	0.0
5	4	4	9	9	1	Closed	Line	NO	0.01000	0.08500	0.17600	0.0	0.0	0.0
6	5	5	6	6	1	Closed	Line	NO	0.03900	0.17000	0.35800	0.0	0.0	0.0
7	6	6	7	7	1	Closed	Line	NO	0.01190	0.10080	0.20900	0.0	0.0	0.0
8	7	7	8	8	1	Closed	Line	NO	0.00850	0.07200	0.14900	0.0	0.0	0.0
9	8	8	9	9	1	Closed	Line	NO	0.03200	0.16100	0.30600	0.0	0.0	0.0

Fig: Branch Data When Generator 1 And 2 Are Opened

4.3.c.Generator data

	Number of Bus	Name of Bus	ID	Status	Gen MW	Gen Mvar	Set Volt	AGC	AVR	Min MW	Max MW	Min Mvar	Max Mva	Cost Model	Part. Factor
1	1	1	1	Open	0.00	0.00	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00
2	2	2	1	Closed	240.26	3.73	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00
3	3	3	1	Closed	150.00	-15.37	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00

Fig: Generator Data When Generator 1 And 2 Are Opened

4.4 SYSTEM WHEN GENERATOR 2 AND 3 IS OPENED

Simulation results when generator 2 and 3 is opened

4.4.a.Bus data

	Number	Name	Area Name	Nom kV	PU Volt	Volt (kV)	Angle (Deg)	Load MW	Load Mvar	Gen MW	Gen Mvar	Switched Shunts Mvar	Act G Shunt MW	Act B Shunt Mvar	Area Num
1	1	1	1	138.00	0.00003	0.004	100.69			0.00	0.00		0.00	0.00	1
2	2	2	1	138.00	0.55241	76.232	-66.77			0.00	0.00		0.00	0.00	1
3	3	3	1	138.00	1.00000	138.000	-24.53			334.16	439.19		0.00	0.00	1
4	4	4	1	138.00	0.39742	54.844	-83.81						0.00	0.00	1
5	5	5	1	138.00	0.43999	60.718	-77.97	104.47	0.00				0.00	0.00	1
6	6	6	1	138.00	0.76802	105.986	-39.30						0.00	0.00	1
7	7	7	1	138.00	0.61723	85.178	-59.18	96.59	0.00				0.00	0.00	1
8	8	8	1	138.00	0.55241	76.232	-66.77						0.00	0.00	1
9	9	9	1	138.00	0.41929	57.862	-90.60	81.62	0.00				0.00	0.00	1

Fig: Bus Data When Generator 2 And 3 Is Opened

4.4.b.Branch data

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	R	X	B	Lim MVA A	Lim MVA B	Lim MVA C
1	1	1	4	4	1	Closed	Line	NO	0.00000	0.57600	0.00000	0.0	0.0	0.0
2	8	8	2	2	1	Closed	Line	NO	0.00000	0.06250	0.00000	0.0	0.0	0.0
3	3	3	6	6	1	Closed	Line	NO	0.00000	0.05860	0.00000	0.0	0.0	0.0
4	4	4	5	5	1	Closed	Line	NO	0.01700	0.09200	0.15800	0.0	0.0	0.0
5	4	4	9	9	1	Closed	Line	NO	0.01000	0.08500	0.17600	0.0	0.0	0.0
6	5	5	6	6	1	Closed	Line	NO	0.03900	0.17000	0.35800	0.0	0.0	0.0
7	6	6	7	7	1	Closed	Line	NO	0.01190	0.10080	0.20900	0.0	0.0	0.0
8	7	7	8	8	1	Closed	Line	NO	0.00850	0.07200	0.14900	0.0	0.0	0.0
9	8	8	9	9	1	Closed	Line	NO	0.03200	0.16100	0.30600	0.0	0.0	0.0

Fig: Branch Data When Generator 2 And 3 Is Opened

4.4.c.Generator data

	Number of Bus	Name of Bus	ID	Status	Gen MW	Gen Mvar	Set Volt	AGC	AVR	Min MW	Max MW	Min Mvar	Max Mva	Cost Model	Part. Factor
1	1	1	1	Open	0.00	0.00	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00
2	2	2	1	Closed	240.26	3.73	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00
3	3	3	1	Closed	150.00	-15.37	1.00000	YES	YES	0.00	1000.00	-9900.00	9900.00	Cubic	10.00

Fig: Generator Data When Generator 2 And 3 Is Opened

4.5 SYSTEM WHEN GENERATOR 1 AND 3 ARE OPENED

Simulation results when generator 1 and 3 is opened are

4.5.a.Bus data

	Number	Name	Area Name	Nom kV	PU Volt	Volt (kV)	Angle (Deg)	Load MW	Load Mvar	Gen MW	Gen Mvar	Switched Shunts Mvar	Act G Shunt MW	Act B Shunt Mvar	Area Num
1	1	1	1	138.00	0.87243	120.396	-40.90			0.00	0.00		0.00	0.00	1
2	2	2	1	138.00	1.00000	138.000	0.00			400.93	155.26		0.00	0.00	1
3	3	3	1	138.00	0.91138	125.771	-32.50			0.00	0.00		0.00	0.00	1
4	4	4	1	138.00	0.87243	120.396	-40.90						0.00	0.00	1
5	5	5	1	138.00	0.86894	119.914	-44.75	150.00	0.00				0.00	0.00	1
6	6	6	1	138.00	0.91138	125.771	-32.50						0.00	0.00	1
7	7	7	1	138.00	0.91684	126.524	-25.38	100.00	0.00				0.00	0.00	1
8	8	8	1	138.00	0.93709	129.318	-15.51						0.00	0.00	1
9	9	9	1	138.00	0.86328	119.133	-37.25	125.00	0.00				0.00	0.00	1

Fig: Bus Data When Generator 1 And 3 is Opened

4.5.b.Branch data

	From Number	From Name	To Number	To Name	Circuit	Status	Branch Device Type	Xfrmr	R	X	B	Lim MVA A	Lim MVA B	Lim MVA C
1	1	1	4	4	1	Closed	Line	NO	0.00000	0.57600	0.00000	0.0	0.0	0.0
2	8	8	2	2	1	Closed	Line	NO	0.00000	0.06250	0.00000	0.0	0.0	0.0
3	3	3	6	6	1	Closed	Line	NO	0.00000	0.05860	0.00000	0.0	0.0	0.0
4	4	4	5	5	1	Closed	Line	NO	0.01700	0.09200	0.15800	0.0	0.0	0.0
5	4	4	9	9	1	Closed	Line	NO	0.01000	0.08500	0.17600	0.0	0.0	0.0
6	5	5	6	6	1	Closed	Line	NO	0.03900	0.17000	0.35800	0.0	0.0	0.0
7	6	6	7	7	1	Closed	Line	NO	0.01190	0.10080	0.20900	0.0	0.0	0.0
8	7	7	8	8	1	Closed	Line	NO	0.00850	0.07200	0.14900	0.0	0.0	0.0
9	8	8	9	9	1	Closed	Line	NO	0.03200	0.16100	0.30600	0.0	0.0	0.0

Fig: Branch Data When Generator 1 And 3 is Opened

4.5.c.Generator data

	Number of Bus	Name of Bus	Area Name of Load	Zone Name of Load	ID	Status	MW	Mvar	MVA	S MW	S Mvar	Dist Status	Dist MW Input	Dist Mvar Input
1	5	5	1	1	1	Closed	150.00	0.00	150.00	150.00	0.00	Closed	0.00	0.00
2	7	7	1	1	1	Closed	100.00	0.00	100.00	100.00	0.00	Closed	0.00	0.00
3	9	9	1	1	1	Closed	125.00	0.00	125.00	125.00	0.00	Closed	0.00	0.00

Fig: Generator Data When Generator 1 And 3 is Opened

V COST ANALYSIS

5.1 OPERATING COST :

The factors influencing power generation at minimum cost are operating efficiencies of generators, fuel cost, and transmission losses. The most efficient generator in the system does not guarantee minimum cost as it may be located in an area where fuel cost is high. Also,if the plant is located far from the load center, transmission losses may be considerably higher and hence the plant may be overly uneconomical. Hence,the problem is to determine the generation of different plants such that the total operating cost is minimum. The operating cost plays an important role in the economic scheduling and are discussed here.

The input to the thermal plant is generally measured in Btu/h, and the output is measured in MW. A simplified input-output curve of a thermal unitKnown as heat-rate curve .

Converting the ordinate of heat-rate curve from Btu/h to Rs/h results in the fuel-cost cure. In all practical cases, the fuel cost of generator I can be represented as a quadratic function of real power generation

$$C_i=\alpha_i+\beta_i p_i+\gamma_i p_i^2$$

An important characteristic is obtained by plotting the derivative of the fuel-cost curve versus the real power. This is known as the incremental fuel-cost curve

$$\frac{dC_i}{dP_i}=2\,\gamma_i P_i+\beta_i$$

5.2 ECONOMIC DISPATCH BY NEGLECTING LOSSES

Since transmission losses are neglected, the total demand P_D is the sum of all generation . A cost function C_i is assumed to be known for each plant. The problem is to find the real power generation for each plant such that the objective function as defined by the equation.

$$C_t=\sum_{i=1}^{n_g} C_I$$

$$=\sum_{i=1}^{n} \alpha_i+\beta_i P_i+\gamma_i P_i^2 \quad \text{...................equ.1}$$

Is minimum, subject to the constraint

$$=\sum_{n=1}^{n_g} P_i=P_D \text{.....................equ.2}$$

Where C_t is the total production cost, $C_i$is the production cost of ith plant, p_i is the generation of ith plant, $p_D$is the total load demand, and n_g is the total number of dispatchable generating plants.

A typical approach is to augment the constraints into objective function by using the lagrange multipliers

$$\pounds=C_t+\lambda(P_D-\sum_{i=1}^{n_g} P_i) \quad \text{.......................equ.3}$$

The minimum of this unconstrained function is found at the point where the partials of the function to its variables are zero.

$$\frac{\partial \pounds}{\partial P_i}=0 \quad \text{.....................equ.4}$$

$$\frac{\partial \pounds}{\partial \lambda}=0 \quad \text{......................equ.5}$$

First condition, given by (equ.4), results in

$$\frac{\partial C_t}{\partial P_i}+\lambda(0-1)=0 \text{Since}$$

$C_t= C_1+ C_2+\ldots\ldots+ C_{n_g}$ then

$$\frac{\partial C_t}{\partial P_i}=\frac{dC_t}{dP_i}=\lambda$$

And therefore the condition for optimum dispatch is

$$\frac{dC_t}{dP_i}=\lambda \qquad i=1\ldots\ldots,n_g \qquad \text{...................equ.6or}$$

$$\beta_i+2\,\gamma_i P_i=\lambda \qquad \text{.....................equ.7}$$

Second condition, given by (equ.5), result in

$$\sum_{n=1}^{n_g} P_i=P_D \qquad \text{......................equ.8}$$

Equation (equ.8) is precisely the equality constraint that was to be imposed. In summary, when losses are neglected with no generator limits, for most economic operation, all plants must operate at equal incremental production cost while satisfying the equality constraint given by (equ.8). In order to find the solution, (equ.7) is solved for p_i.

$$P_i=\frac{\lambda-\beta_i}{2\gamma_i} \qquad \text{.....................equ.9}$$

The relations given by (equ.9) are known as the coordination equations. They are functions of λ. An analytical solution can be obtained for λ by substituting for p_i in (equ.8).

$$\sum_{i=1}^{n_g}\left(\frac{\lambda-\beta_i}{2\gamma_i}\right)=P_D \qquad \text{.....................equ.10or}$$

$$\lambda=\frac{P_D+\sum_{i=1}^{n_g}\frac{\beta_i}{2\gamma_i}}{\sum_{i=1}^{n_g}\frac{1}{2\gamma_i}} \qquad \text{......................equ.11}$$

The value of λ found from (equ.11) is substituted in (equ.9) to obtain the optimal scheduling of generation

VI CONCLUSION

This project attains the objective to minimize the total generation cost (including fuel cost, plus emission cost, plus operation/maintenance cost, plus network loss cost) by meeting the operational constraints like System load demand,Lower and upper economic limits of each generating unit,Downward-and-upward regulating margin requirements of the system at optimum level.

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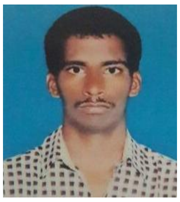

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